ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

Applicant:	Murata Manufacturing Co., Ltd. 10-1, Higashikotari, Nagaokakyo-shi, Kyoto 617-8555 Japan
Manufacturer:	Murata Manufacturing Co., Ltd. 10-1, Higashikotari, Nagaokakyo-shi, Kyoto 617-8555 Japan
Product Name:	Communication Module
Brand Name:	muRata
Model No.:	For FCC： LBES5PL2EL, LBEE5PL2DL For ISED： LBES5PL2EL-SANT, LBES5PL2EL-DANT, LBEE5PL2DL-SANT, LBEE5PL2DL-DANT
Model Difference:	Refer to section 1.8
Report Number:	TERF2211002512E2
FCC ID	VPYLBES5PL2EL
IC:	772C-LBES5PL2EL
Date of EUT Received:	Nov. 25, 2022
Date of Test:	Feb. 04, 2023～Feb. 15, 2023
Issue Date:	Mar. 22, 2023

Approved By Arno Hsieh

Arno Hsieh

We hereby certify that:

The above equipment was tested by SGS Taiwan Ltd. Central RF Lab The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10:2013 and the energy emitted by the sample EUT comply with FCC rule part §15.247, ISED RSS-247.

The results of this report relate only to the sample identified in this report.

Revision History

Report Number	Revision	Description	Issue Date	Revised By	Remark
TERF2211002512E2	00	Original	Mar. 02, 2023	Yami Kuo	
TERF2211002512E2	01	Revise applicant's address and model difference	Mar. 22, 2023	Yami Kuo	*

Note:

1、 The remark "*" indicates modification of the report upon requests from certification body.

2、 Variant information of model numbers is provided by the applicant, test results of this report are applicable to the sample EUT(s) received.

Table of Contents

1 GENERAL INFORMATION

1.1 Product Description

Product Name:	Communication Module	
Brand Name:	muRata	
Model No.:	For FCC	LBES5PL2EL, LBEE5PL2DL
	For ISED	LBES5PL2EL-SANT, LBES5PL2EL-DANT, LBEE5PL2DL-SANT, LBEE5PL2DL-DANT
Model Difference:	Refer to section 1.8	
Hardware Version:	1	
Firmware Version:	N/A	
EUT Series No.:	ANT0: L#1 ANT1: R#1	
Power Supply:	3.3Vdc, 1.8Vdc	
Test Software (Name/Version)	Tera Term V4.106	

1.2 RF Specification

Radio Technology:	BLE
Frequency Range:	2402 – 2480MHz
Channel number:	40 channels
Modulation type:	GFSK
Transmit Power:	ANT0 BLE 1M: 15.29 dBm BLE 2M: 15.32 dBm ANT1 BLE 1M: 15.97 dBm BLE 2M: 15.89 dBm

1.3 Antenna Designation

ANT0

Antenna Type	Supplier	Antenna Part No.	Freq. (MHz)	Peak Antenna Gain (dBi)
Dipole	Molex	146153	2400~2500	**3.2**
	Molex	219611	2400~2500	2.67
	Unictron	WT32D1-KX	2400~2500	3
	Inventek	W24P-U	2400~2500	3.2
Monopole	Murata	Type2EL_Antenna	2400~2500	**3.6**

ANT1

Antenna Type	Supplier	Antenna Part No.	Freq. (MHz)	Peak Antenna Gain (dBi)
Dipole	Molex	146153	2400~2500	**3.2**
	Molex	219611	2400~2500	2.67
	Unictron	WT32D1-KX	2400~2500	3
	Inventek	W24P-U	2400~2500	3.2

Note:

1. Pre-scanned was done on the above antennas, measurements were demonstrated by using the antenna with the highest gain as the worst case scenarios.
2. Antenna information is provided by the applicant.

1.4 Test Methodology of Applied Standards

FCC Part 15, Subpart C §15.247
FCC KDB 558074 D01 15.247 Meas Guidance v05r02
RSS-247 issue 2 Feb. 2017
RSS-Gen, Issue 5 April 2018
ANSI C63.10:2013

1.5 Test Facility

Laboratory	Test Site Address	Test Site Name	FCC Designation number	IC CAB identifier
SGS Taiwan Ltd. Central RF Lab. (TAF code 3702)	No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan.	SAC 1	TW0027	TW3702
		SAC 2		
		SAC 3		
		Conduction 1		
		Conducted 1		
		Conducted 2		
		Conducted 3		
		Conducted 4		
		Conducted 5		
		Conducted 6		
	No.2, Keji 1st Rd., Guishan District, Taoyuan City, Taiwan 333	Conduction C	TW0028	
		SAC C		
		SAC D		
		SAC G		
		Conducted A		
		Conducted B		
		Conducted C		
		Conducted D		
		Conducted E		
		Conducted F		
		Conducted G		

Note: Test site name is remarked on the equipment list in each section of this report as an indication where measurements occurred in specific test site and address.

1.6 Special Accessories

There are no special accessories used while test was conducted.

1.7 Equipment Modifications

There was no modification incorporated into the EUT.

1.8 Model Difference

1. There are 4 HVINs with 2 PMNs as below

a. The LBES5PL2EL-SANT and LBES5PL2EL-DANT are electrically identical.

HVIN	PMN	Chip on C101	RF functionss
LBES5PL2EL-SANT	LBES5PL2EL	IW612	WLAN 2.4GHz,5GHz, BT,BLE, IEEE802.15.4
LBES5PL2EL-DANT			

b. The LBEE5PL2DL-SANT and LBEE5PL2DL-DANT are electrically identical.

HVIN	PMN	Chip on C101	RF functions
LBEE5PL2DL-SANT	LBEE5PL2DL	IW611	WLAN 2.4GHz,5GHz, BT,BLE
LBEE5PL2DL-DANT			

2. In addition, there are 2 HMNs, the differences between the HMN(s) are

HMN	HVIN	Antenna connector(s)	WLAN	BT	BLE	IEEE802.15.4
P2ML10229-D	LBES5PL2EL-DANT	2 (ANT0, ANT1)	ANT0	ANT1	ANT1	ANT1
	LBEE5PL2DL-DANT					NA
P2ML10229-S	LBES5PL2EL-SANT	1 (ANT0)	ANT0	ANT0	ANT0	ANT0
	LBEE5PL2DL-SANT					NA

2 SYSTEM TEST CONFIGURATION

2.1 EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

2.2 EUT Exercise

An engineering test mode (software/firmware) that applicant provided was utilized to manipulate the EUT into transmit, selection of the test channel, and modulation scheme.

2.3 Test Procedure

2.3.1 Conducted Emissions

The EUT is a placed on a table which is 0.8 m above ground plane. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz. The CISPR Quasi-Peak and Average detector mode is employed. The two LISNs provide 50uH/50 ohm of coupling impedance for the measuring instrument. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

2.3.2 Conducted Test (RF)

The active antenna port of the unlicensed wireless device is connected to the spectrum analyzer with attenuator to protect the instrumentation. If a second antenna port is available, it is tested at one operating frequency, with other port(s) appropriately terminated, to verify it has similar output characteristics as the fully tested port.

2.3.3 Radiated Emissions

The EUT is a placed on a turn table. For emissions testing at or below 1 GHz, the table height shall be 0.8 m above the reference ground plane. For emission measurements above 1 GHz, the table height shall be 1.5 m. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this transmitter (EUT) was rotated through three orthogonal axes and measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made “while keeping the antenna in the ‘cone of radiation’ from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response.” is still within the 3dB illumination BW of the measurement antenna.

2.4 Measurement Results Explanation Example

2.4.1 Radiated Emission Test Sites For Measurements From 9 kHz To 30 MHz

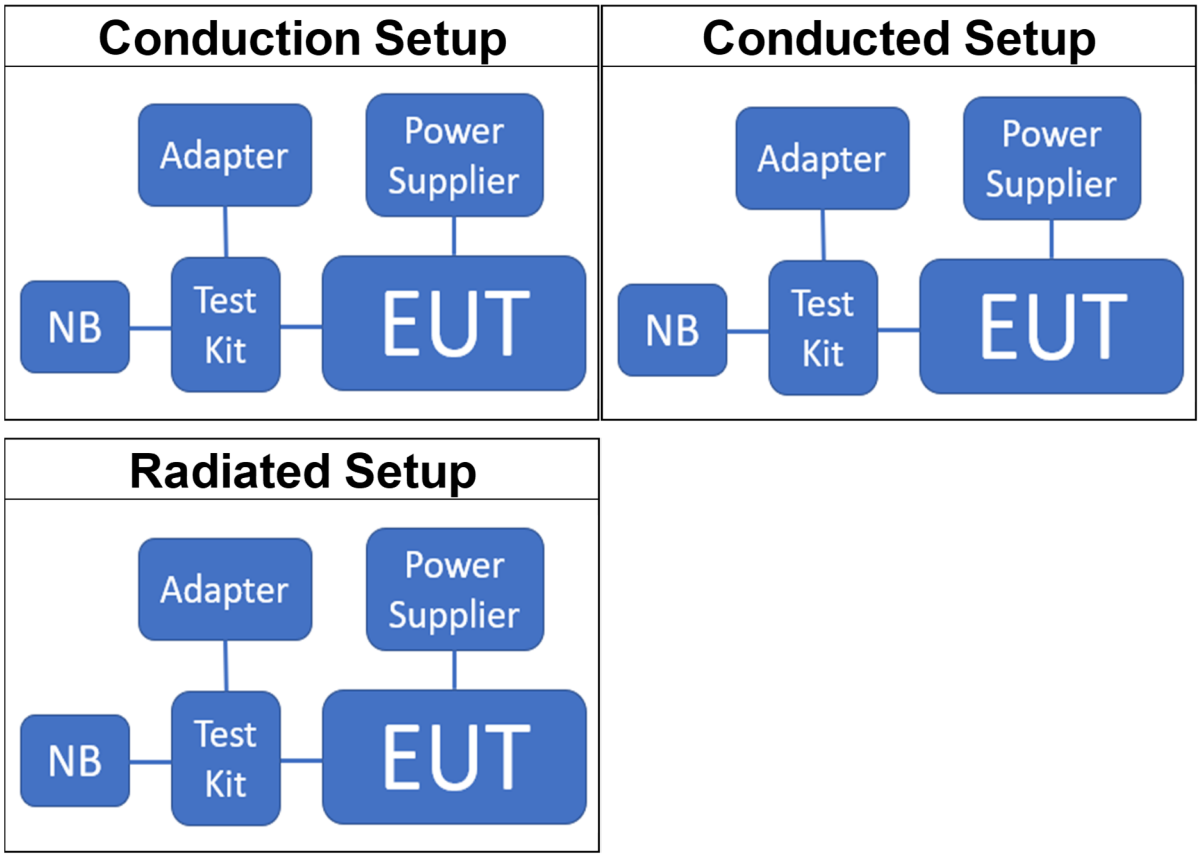
Radiated emission below 30MHz is measured in a 9m*6m*6m semi-anechoic chamber, the measurements correspond to those obtained at an open-field test site.

There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

2.4.2 For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuation factor between EUT conducted port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly EUT RF output level.

2.5 Test Configuration



2.6 Control Unit(s)

AC Power-Line Conducted Emission Test Site: Conduction C					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Notebook	Lenovo	T440p	P0000665	N/A	N/A
USB Cable	ZHUANG SHAN CHUAN	E333601	N/A	N/A	N/A
Adapter	EDACPOWER	EA1045CR	N/A	N/A	N/A

Conducted Emission Test Site: Conducted D					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
USB Cable	ZHUANG SHAN	E333601	N/A	N/A	N/A
Adapter	EDACPOWER	EA1045CR	N/A	N/A	N/A
Notebook	Lenovo	T420	S0012599	N/A	N/A

Radiated Emission Test Site: SAC C					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Notebook	Lenovo	T440p	P0000665	N/A	N/A
USB Cable	ZHUANG SHAN CHUAN	E333601	N/A	N/A	N/A
Adapter	EDACPOWER	EA1045CR	N/A	N/A	N/A

3 SUMMARY OF TEST RESULTS

FCC Rules	ISED Rules	Description Of Test	Result
§15.207(a)	RSS-Gen §8.8	AC Power Line Conducted Emission	Compliant
§15.247(b) (3)	RSS-247 §5.4 d	Peak Output Power	Compliant
§15.247(a)(2)	RSS-247 §5.2 a RSS-Gen §6.7	Emission Bandwidth	Compliant
§15.247(d) §15.205 §15.209	RSS-247 §5.5 RSS-Gen §8.9 RSS-Gen §8.10	Radiated & Conducted Band Edge and Spurious Emission	Compliant
§15.247(e)	RSS-247 §5.2 b	Peak Power Density	Compliant
§15.203	N/A	Antenna Requirement	Compliant

4 DESCRIPTION OF TEST MODES

4.1 Operating Frequencies

ITEM	FREQUENCY	ITEM	FREQUENCY	ITEM	FREQUENCY
1	2402 MHz	15	2430 MHz	29	2458 MHz
2	2404 MHz	16	2432 MHz	30	2460 MHz
3	2406 MHz	17	2434 MHz	31	2462 MHz
4	2408 MHz	18	2436 MHz	32	2464 MHz
5	2410 MHz	19	2438 MHz	33	2466 MHz
6	2412 MHz	20	2440 MHz	34	2468 MHz
7	2414 MHz	21	2442 MHz	35	2470 MHz
8	2416MHz	22	2444 MHz	36	2472 MHz
9	2418 MHz	23	2446 MHz	37	2474 MHz
10	2420 MHz	24	2448 MHz	38	2476 MHz
11	2422 MHz	25	2450 MHz	39	2478 MHz
12	2424 MHz	26	2452 MHz	40	2480 MHz
13	2426 MHz	27	2454 MHz		
14	2428 MHz	28	2456 MHz		

4.2 The Worst Test Modes and Channel Details

1. The EUT has been tested under operating condition.
2. Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.
3. The field strength of radiation emission was measured as the EUT positioned in different orthogonal planes (E1/E2/H) based on actual usage of the EUT to pre-scan the emissions for determining the worst case scenario.
4. Investigation has been done on all the possible configurations for searching the worst case.

CONDUCTED TEST				
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)
Bluetooth LE	0 to 39	0,20,39	GFSK	1
Bluetooth LE	0 to 39	0,20,39	GFSK	2

RADIATED EMISSION TEST (BELOW 1 GHz)				
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)
Bluetooth LE	0 to 39	20	GFSK	1
Bluetooth LE	0 to 39	20	GFSK	2

RADIATED EMISSION TEST (ABOVE 1 GHz)				
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)
Bluetooth LE	0 to 39	0,20,39	GFSK	1
Bluetooth LE	0 to 39	0,20,39	GFSK	2

5 MEASUREMENT UNCERTAINTY

Test Items	Uncertainty		
AC Power Line Conducted Emission	+/-	2.32	dB
Output Power measurement	+/-	1	dB
Emission Bandwidth	+/-	1.53	Hz
Undesignable radiated emission measurement	+/-	1.68	dB
Peak Power Density	+/-	2.16	dB
Temperature	+/-	0.7	°C
Humidity	+/-	3	%
DC / AC Power Source	+/-	1	%

Radiated Spurious Emission Measurement Uncertainty				
Polarization: Vertical	**+/-**	**2.8**	**dB**	9kHz~30MHz
	+/-	**4.82**	**dB**	30MHz - 1000MHz
	+/-	**4.37**	**dB**	1GHz - 18GHz
	+/-	**4.21**	**dB**	18GHz - 40GHz
Polarization: Horizontal	**+/-**	**2.8**	**dB**	9kHz~30MHz
	+/-	**4.54**	**dB**	30MHz - 1000MHz
	+/-	**4.37**	**dB**	1GHz - 18GHz
	+/-	**4.21**	**dB**	18GHz - 40GHz

Note:

1. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.
2. The conformity assessment statement in this report is based solely on the test results, measurement uncertainty is excluded.

6 MEASUREMENT EQUIPMENT USED

6.1 Emission from AC power line

AC Power-Line Conducted Emission Test Site: Conduction C					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
LISN	SCHWARZBECK Mess-Elektronik	NSLK8127	973	04/13/2022	04/12/2023
EMI Test Receiver	R&S	ESCI	101342	04/25/2022	04/24/2023
Coaxial Cable	EC Lab	RF-HY-CAB-250	RF-HY-CAB-250-01	03/27/2022	03/26/2023
Pulse Limiter	EC Lab	VTSD 9561F-N	485	03/27/2022	03/26/2023
DC Power Supply	Agilent	E3640A	MY53170008	09/12/2022	09/11/2023
Test Software	audix	e3	E3 20923 SGS Ver.9 (C)	N.C.R	N.C.R

6.2 Conducted Measurement

Conducted Emission Test Site: Conducted D					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	KEYSIGHT	N9010B	MY59071573	05/16/2022	05/15/2023
Power Meter	Anritsu	ML2496A	1512003	07/26/2022	07/25/2023
Power Sensor	Anritsu	MA2411B	1339378	07/26/2022	07/25/2023
Power Sensor	Anritsu	MA2411B	1339379	07/26/2022	07/25/2023
DC Power Supply	Agilent	E3640A	MY53170008	09/12/2022	09/11/2023
Test Software	SGS Taiwan	Radio Test Software	Ver.21	N.C.R	N.C.R
Attenuator	Woken	WATT-218FS-10	RF17	11/16/2022	11/15/2023
Attenuator	Woken	WATT-218FS-10	RF18	11/16/2022	11/15/2023
Switch E-Channel	E-Channel	ETF-1801 RF Switch	EC2100175	11/16/2022	11/15/2023
DC Block	PASTERNACK	PE8210	RF158	11/16/2022	11/15/2023

6.3 Radiated Measurement

Radiated Emission Test Site: SAC C					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Broadband Antenna	SCHWARZBECK	VULB 9168	9168-300	11/11/2022	11/10/2023
Horn Antenna	Schwarzbeck	BBHA9170	185	08/22/2022	08/21/2023
Horn Antenna	Schwarzbeck	BBHA9120D	1187	01/12/2023	01/11/2024
Loop Antenna	ETS.LINDGREN	6502	143303	05/14/2022	05/13/2023
3m Site NSA	SGS	966 chamber C	N/A	03/02/2022	03/01/2023
Spectrum Analyzer	KEYSIGHT	N9010A	MY57120290	04/01/2022	03/31/2023
DC Power Supply	Agilent	E3640A	MY53170008	09/12/2022	09/11/2023
Test Software	audix	e3	E3 20923 SGS Ver.9 (C)	N.C.R	N.C.R
Pre-Amplifier	EMC Instruments	EMC330	980096	11/16/2022	11/15/2023
Pre-Amplifier	EMC Instruments	EMC0011830	980199	11/16/2022	11/15/2023
Pre-Amplifier	EMC Instruments	EMC18405SEE	980881	10/25/2022	10/24/2023
Attenuator	Woken	WATT-218FS-10	RF16	11/16/2022	11/15/2023
Coaxial Cable	Huber Suhner	EMC106-SM-SM-9100	150704	11/16/2022	11/15/2023
Coaxial Cable	Huber Suhner	SUCOFLEX 104	MY17388/4	11/16/2022	11/15/2023
Coaxial Cable	Huber Suhner	RG 214/U	W22.03	11/16/2022	11/15/2023

NOTE: *N.C.R refers to Not Calibrated Required.*

7 CONDUCTED EMISSION TEST

7.1 Standard Applicable:

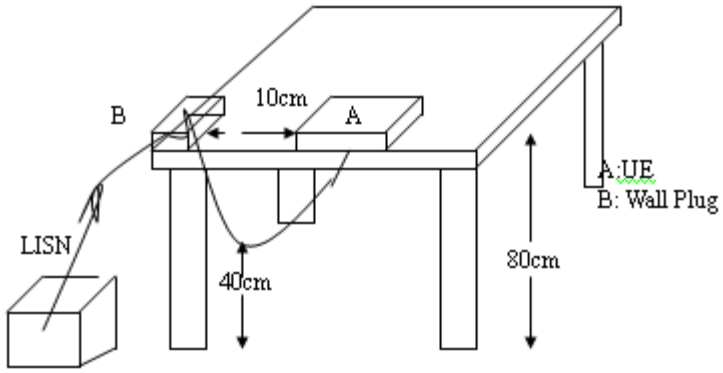
Frequency range within 150kHz to 30MHz shall not exceed the Limit table as below.

Frequency range MHz	Limits (dBμV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50
Note 1.The lower limit shall apply at the transition frequencies 2.The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.		

7.2 EUT Setup:

1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI C63.10:2013.
2. The AC/DC Power adaptor of EUT was plug-in LISN. The EUT was placed flushed with the rear of the table.
3. The LISN was connected with 120Vac/60Hz power source.

7.3 Test Setup



7.4 Measurement Procedure:

1. The EUT was placed on a table which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all phases of power being supplied by given UE are completed

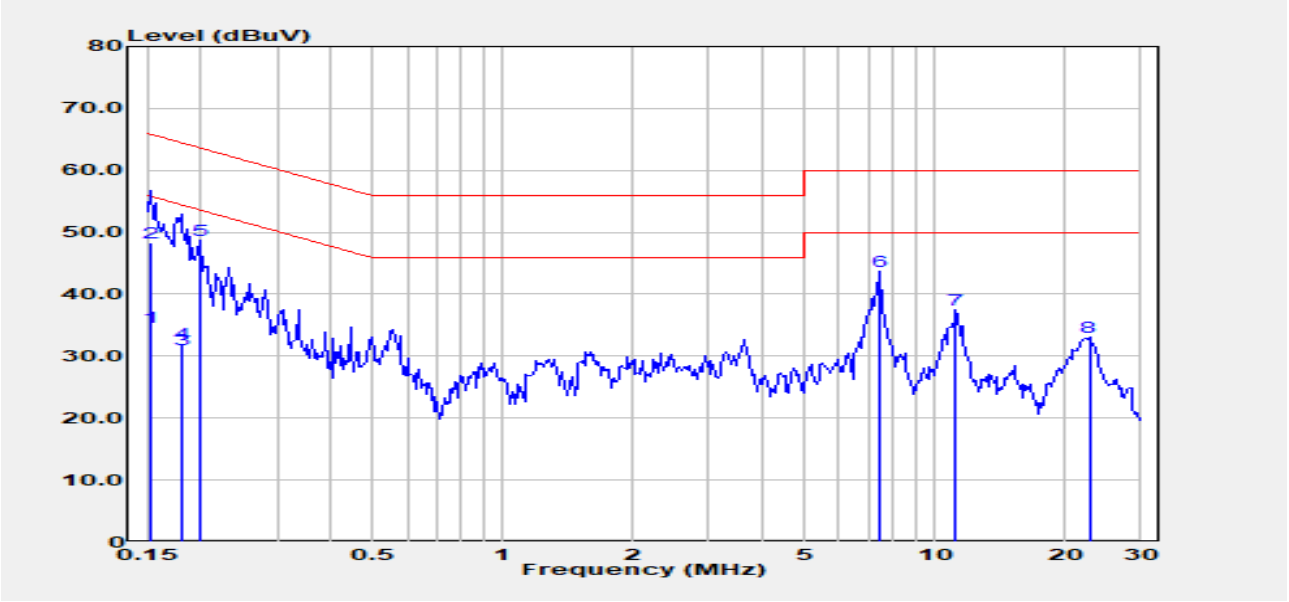
7.5 Measurement Result:

Note: Refer to next page for measurement data and plots.

Note2: The * reveals the worst-case results that closest to the limit.

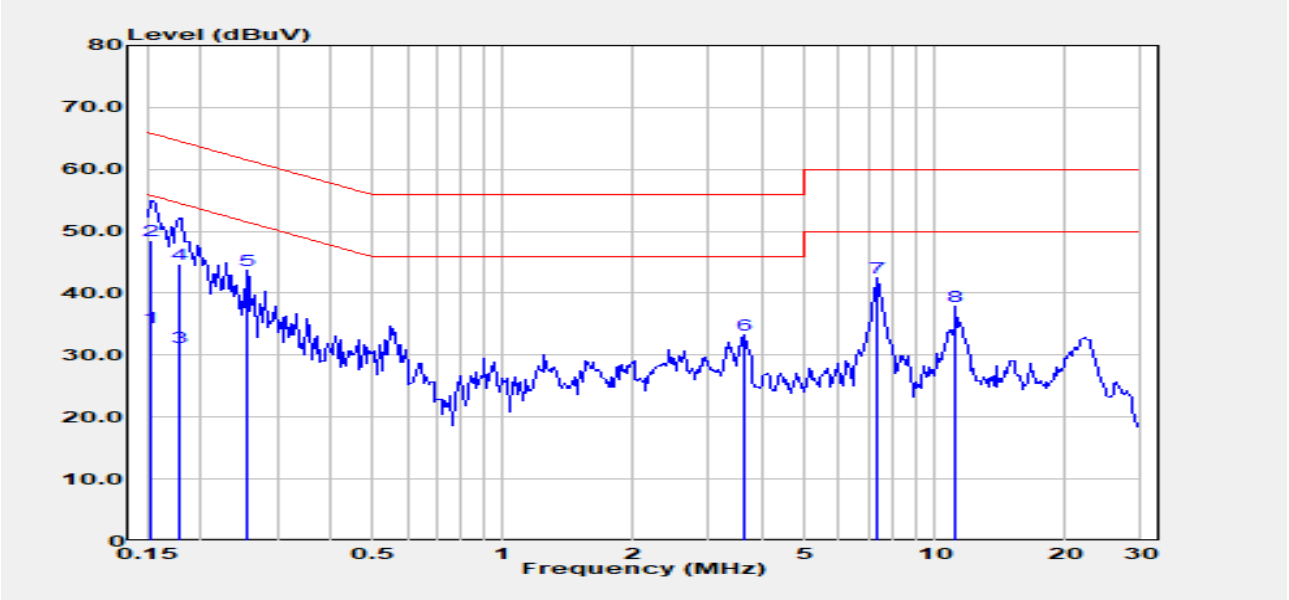
AC POWER LINE CONDUCTED EMISSION TEST DATA

Report Number	:TERF2211002512E2	Test Site	:Conduction C
Test Mode	:BLE	Test Date	:2023-02-15
Power	:120/60Hz	Temp./Humi.	:22.4/61
Probe	:L1	Engineer	:Andy Wang



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV	dBµV	dB
0.153	Average	24.50	10.27	34.77	55.82	-21.05
0.153	QP	38.10	10.27	48.37	65.82	-17.45
0.180	Average	20.90	10.27	31.17	54.50	-23.33
0.180	QP	21.80	10.27	32.07	64.50	-32.43
0.200	Peak	38.49	10.27	48.76	63.62	-14.87
7.486	Peak	33.00	10.61	43.61	60.00	-16.39
11.198	Peak	26.85	10.69	37.54	60.00	-22.46
22.775	Peak	22.16	10.95	33.11	60.00	-26.89

Report Number	:TERF2211002512E2	Test Site	:Conduction C
Test Mode	:BLE	Test Date	:2023-02-15
Power	:120/60Hz	Temp./Humi.	:22.4/61
Probe	:N	Engineer	:Andy Wang



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV	dBµV	dB
0.153	Average	24.30	10.28	34.58	55.82	-21.24
0.153	QP	38.30	10.28	48.58	65.82	-17.24
0.178	Average	21.00	10.27	31.27	54.59	-23.32
0.178	QP	34.50	10.27	44.77	64.59	-19.82
0.255	Peak	33.46	10.28	43.74	61.60	-17.86
3.642	Peak	22.57	10.71	33.28	56.00	-22.72
7.329	Peak	32.04	10.56	42.60	60.00	-17.40
11.198	Peak	27.15	10.65	37.80	60.00	-22.20

8 PEAK OUTPUT POWER MEASUREMENT

8.1 Standard Applicable:

For systems using digital modulation in the 2400-2483.5 MHz bands, the limit for peak output power is 1Watt and the e.i.r.p. shall not exceed 4 W.

If the transmitting antenna of directional gain greater than 6dBi are used the peak output power form the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the Antenna exceeds 6dBi.

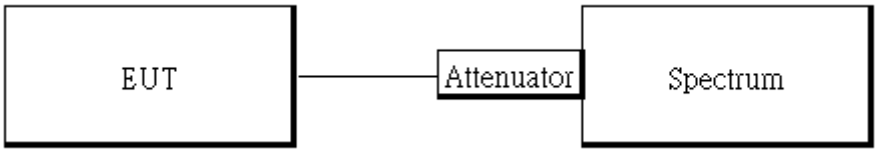
In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of Antenna exceeds 6dBi.

Pre-analysis Check: While conducting average power measurement, duty cycle of each mode shall be checked to ensure its duty cycle in order to compensate for the loss due to insufficient ratio of duty cycle.

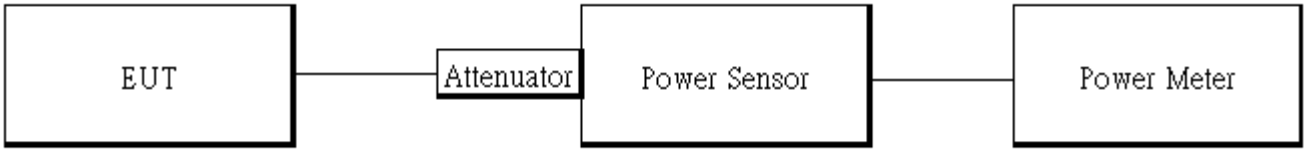
All duty cycle is pre-scanned, and result as obtained below shows only the most representative ones where duty cycle is conducted as the given transmission with given virtual operation that expresses the percentage.

8.2 Test Setup

8.2.1 Duty Cycle



8.2.2 Output Power



8.3 Measurement Procedure:

8.3.1 Duty Cycle

1. Place the EUT on the table and set it in transmitting mode.
2. Set span = Zero
3. RBW = 8MHz, VBW = 8MHz,
4. Detector = Peak

8.3.2 Output Power

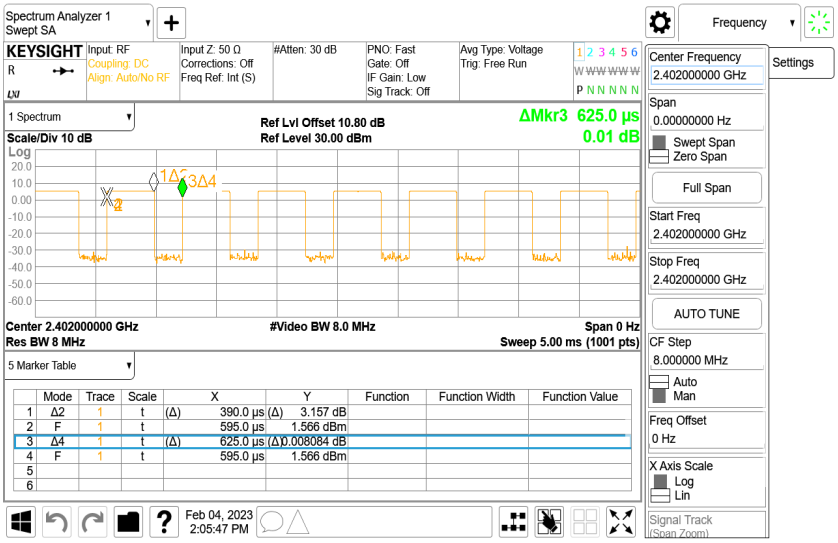
1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power meter.
4. Record the max. Reading as observed from Power Meter.
5. Repeat above procedures until all test default channel measured was complete.

8.4 Duty Factor:

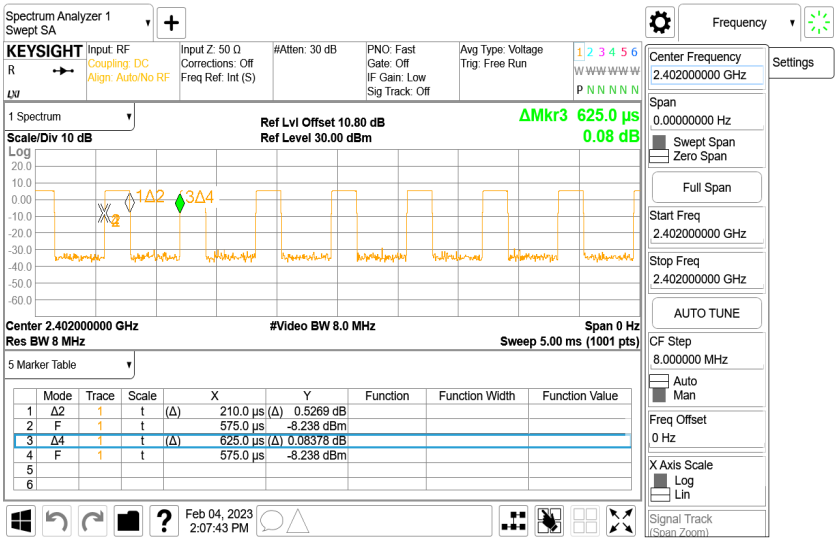
ANT0

	Duty Cycle (%) = Ton / (Ton+Toff)	Duty Factor (dB) =10*log (1/Duty Cycle)	1/T (kHz)	VBW setting (kHz)
BLE 1M	62.40	2.05	2.56	3.00
BLE 2M	33.60	4.74	4.76	5.00

BLE_1M_LowCH00-2402



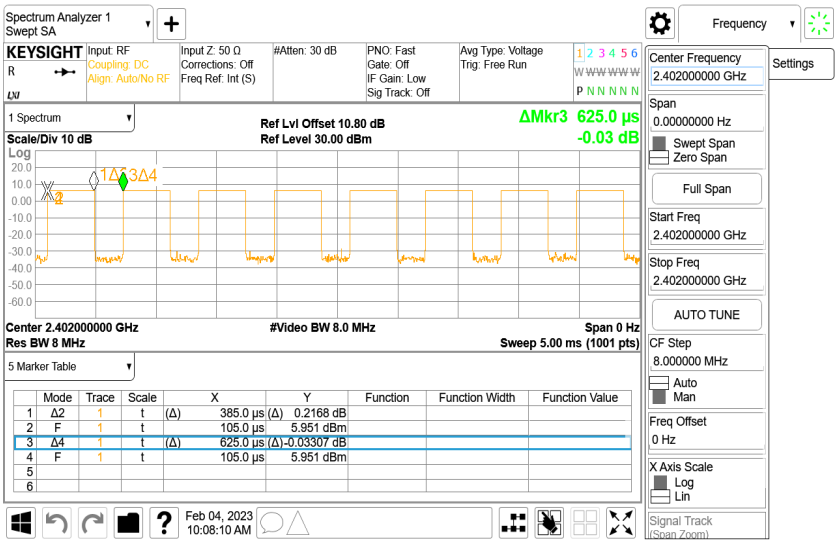
BLE_2M_LowCH00-2402



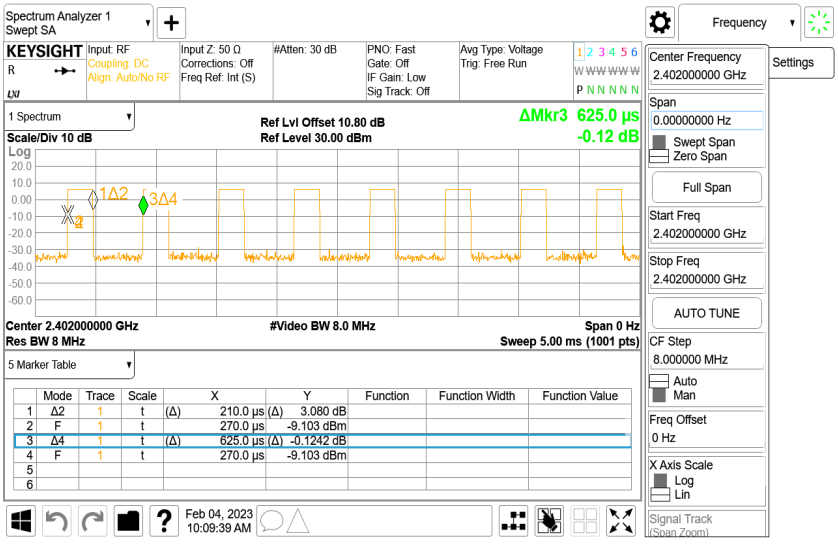
ANT1

	Duty Cycle (%) = Ton / (Ton+Toff)	Duty Factor (dB) =10*log (1/Duty Cycle)	1/T (kHz)	VBW setting (kHz)
BLE 1M	61.60	2.10	2.60	3.00
BLE 2M	33.60	4.74	4.76	5.00

BLE_1M_LowCH00-2402



BLE_2M_LowCH00-2402



8.5 Output Power:

8.5.1 Peak & Avg

ANT0

BLE 1M mode:

CH	Frequency (MHz)	Power set	Peak Power Output (dBm)	Required Limit (dBm)
Low	2402	17	**15.29**	30
Mid	2442	17	15.21	30
High	2480	17	15.13	30
CH	**Frequency (MHz)**	**Power set**	**Max. Avg. Output include tune up tolerance Power (dBm)**	**Required Limit (dBm)**
Low	2402	17	15.24	30
Mid	2442	17	15.16	30
High	2480	17	15.07	30

Note: Measured by power meter, cable loss 10.8 dB + Duty cycle factor has been offseted to the power meter for Avg. power and cable loss has been offseted for Peak power measurement.

BLE 2M mode:

CH	Frequency (MHz)	Power set	Peak Power Output (dBm)	Required Limit (dBm)
Low	2402	17	**15.32**	30
Mid	2442	17	15.23	30
High	2480	17	15.14	30
CH	**Frequency (MHz)**	**Power set**	**Max. Avg. Output include tune up tolerance Power (dBm)**	**Required Limit (dBm)**
Low	2402	17	15.18	30
Mid	2442	17	15.09	30
High	2480	17	15.01	30

Note: Measured by power meter, cable loss 10.8 dB + Duty cycle factor has been offseted to the power meter for Avg. power and cable loss has been offseted for Peak power measurement.

ANT1

BLE 1M mode:

CH	Frequency (MHz)	Power set	Peak Power Output (dBm)	Required Limit (dBm)
Low	2402	16	**15.97**	30
Mid	2442	16	15.83	30
High	2480	16	15.71	30
CH	**Frequency (MHz)**	**Power set**	**Max. Avg. Output include tune up tolerance Power (dBm)**	**Required Limit (dBm)**
Low	2402	16	15.89	30
Mid	2442	16	15.77	30
High	2480	16	15.66	30

Note: Measured by power meter, cable loss 10.8 dB + Duty cycle factor has been offseted to the power meter for Avg. power and cable loss has been offseted for Peak power measurement.

BLE 2M mode:

CH	Frequency (MHz)	Power set	Peak Power Output (dBm)	Required Limit (dBm)
Low	2402	16	**15.89**	30
Mid	2442	16	15.75	30
High	2480	16	15.62	30
CH	**Frequency (MHz)**	**Power set**	**Max. Avg. Output include tune up tolerance Power (dBm)**	**Required Limit (dBm)**
Low	2402	16	15.76	30
Mid	2442	16	15.66	30
High	2480	16	15.53	30

Note: Measured by power meter, cable loss 10.8 dB + Duty cycle factor has been offseted to the power meter for Avg. power and cable loss has been offseted for Peak power measurement.

8.5.2 EIRP

ANT0

EIRP BLE 1M mode

CH	Frequency (MHz)	Power set	Max. Avg. Output include tune up tolerance Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit		
Low	2402	17	15.24	3.60	18.84	4W=	36	dBm
Mid	2442	17	15.16	3.60	18.76	4W=	36	dBm
High	2480	17	15.07	3.60	18.67	4W=	36	dBm

* ***Note:*** EIRP = Average Power + Gain

EIRP BLE 2M mode

CH	Frequency (MHz)	Power set	Max. Avg. Output include tune up tolerance Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit		
Low	2402	17	15.18	3.60	18.78	4W=	36	dBm
Mid	2442	17	15.09	3.60	18.69	4W=	36	dBm
High	2480	17	15.01	3.60	18.61	4W=	36	dBm

* ***Note:*** EIRP = Average Power + Gain

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EIRP BLE 1M mode

CH	Frequency (MHz)	Power set	Max. Avg. Output include tune up tolerance Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit		
Low	2402	16	15.89	3.20	19.09	4W=	36	dBm
Mid	2442	16	15.77	3.20	18.97	4W=	36	dBm
High	2480	16	15.66	3.20	18.86	4W=	36	dBm

* ***Note:*** EIRP = Average Power + Gain

EIRP BLE 2M mode

CH	Frequency (MHz)	Power set	Max. Avg. Output include tune up tolerance Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit		
Low	2402	16	15.76	3.20	18.96	4W=	36	dBm
Mid	2442	16	15.66	3.20	18.86	4W=	36	dBm
High	2480	16	15.53	3.20	18.73	4W=	36	dBm

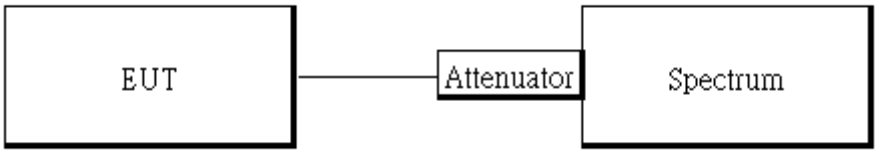
* ***Note:*** EIRP = Average Power + Gain

9 EMISSION BANDWIDTH MEASUREMENT

9.1 Standard Applicable

The minimum 6 dB bandwidth shall be at least 500 kHz .

9.2 Test Setup



9.3 Measurement Procedure:

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.

9.3.1 FCC measurements

1. The testing follows the Measurement Procedure of the KDB 558074 D01.
2. Set the spectrum analyzer as
   RBW= 100 kHz ,
   VBW = 3 X RBW,
   Span= 2 to 5 times of the OBW,
   Sweep=auto, Detector = Peak, and Max hold.
3. Mark the upper and lower frequencies of -6dB.
4. Repeat above procedures until all test default channel is completed.

9.3.2 ISED measurements

1. The testing follows the Measurement Procedure of the RSS-Gen section 6.7.
2. Set the spectrum analyzer as
   RBW= 1 % to 5% of 99% and -6dB Bandwidth ,
   VBW ≥ 3 X RBW,
   Span= large enough to capture all products of the modulation process
   Sweep=auto, Detector = Peak, and Max hold.
3. Mark the upper and lower frequencies of 99% and -6dB.
4. Repeat above procedures until all test default channel is completed.

9.4 Measurement Result:

ANT0

BLE 1M mode

Frequency (MHz)	6dB BW (MHz)	Required BW (MHz)	Result
2402	0.7487	≧ 0.5	PASS
2442	0.7495	≧ 0.5	PASS
2480	0.7493	≧ 0.5	PASS

BLE 2M mode

Frequency (MHz)	6dB BW (MHz)	Required BW (MHz)	Result
2402	1.224	≧ 0.5	PASS
2442	1.223	≧ 0.5	PASS
2480	1.222	≧ 0.5	PASS

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BLE 1M mode

Frequency (MHz)	6dB BW (MHz)	Required BW (MHz)	Result
2402	0.7472	≧ 0.5	PASS
2442	0.7489	≧ 0.5	PASS
2480	0.7485	≧ 0.5	PASS

BLE 2M mode

Frequency (MHz)	6dB BW (MHz)	Required BW (MHz)	Result
2402	1.226	≧ 0.5	PASS
2442	1.225	≧ 0.5	PASS
2480	1.224	≧ 0.5	PASS

ANT0

BLE 1M mode

Frequency (MHz)	99%Bandwidth (MHz)
2402	1.0292
2442	1.0294
2480	1.0288

BLE 2M mode

Frequency (MHz)	99%Bandwidth (MHz)
2402	2.0353
2442	2.0364
2480	2.0356

ANT1

BLE 1M mode

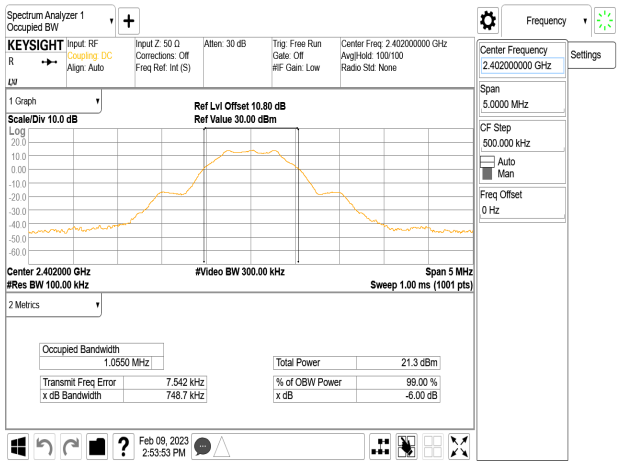
Frequency (MHz)	99%Bandwidth (MHz)
2402	1.0293
2442	1.0287
2480	1.0297

BLE 2M mode

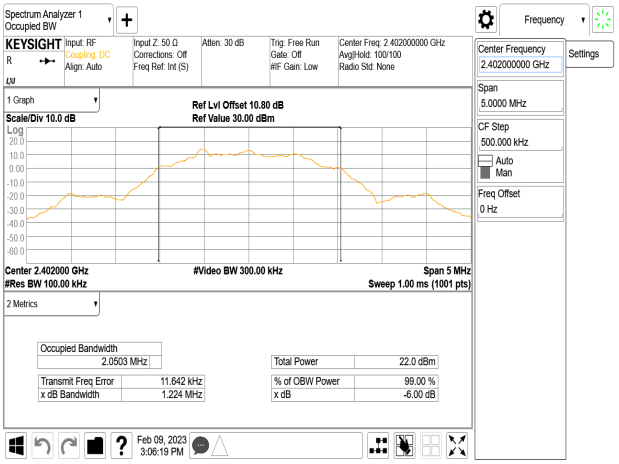
Frequency (MHz)	99%Bandwidth (MHz)
2402	2.0367
2442	2.0365
2480	2.0368

ANT0

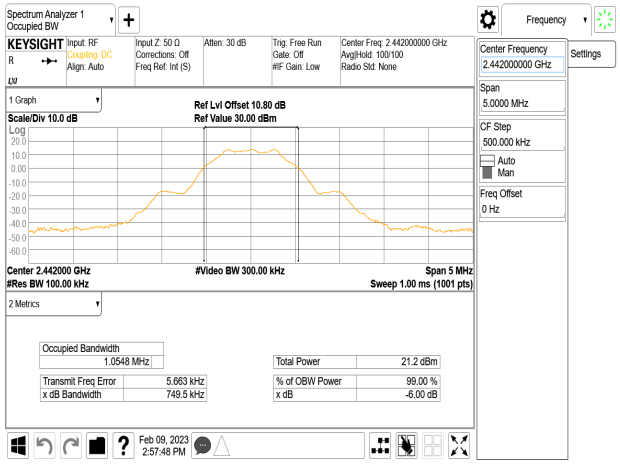
OBW_BLE 1M_LowCH00-2402MHz



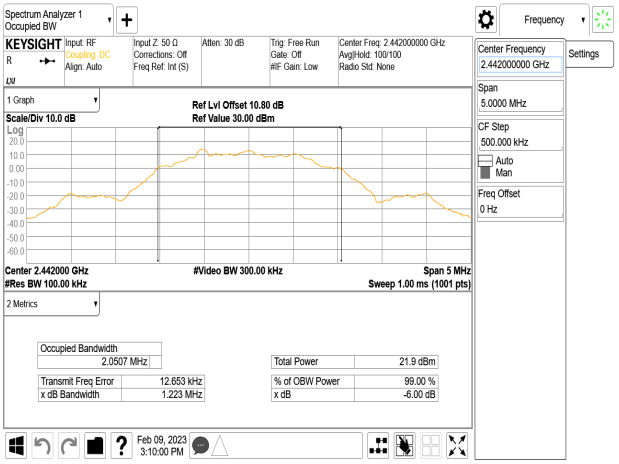
OBW_BLE 2M_LowCH00-2402MHz



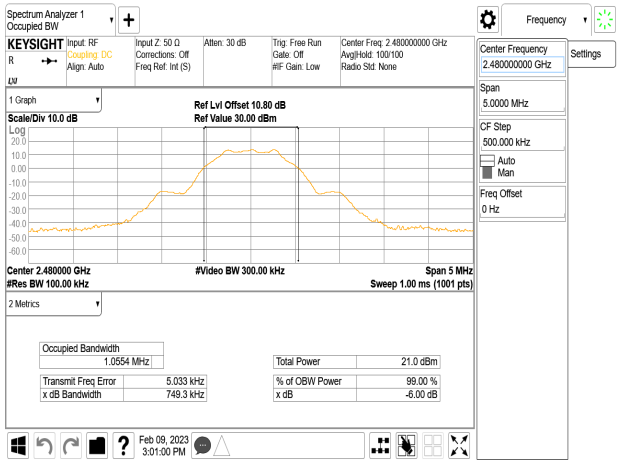
OBW_BLE 1M_MidCH20-2442MHz



OBW_BLE 2M_MidCH20-2442MHz



OBW_BLE 1M_HighCH39-2480MHz



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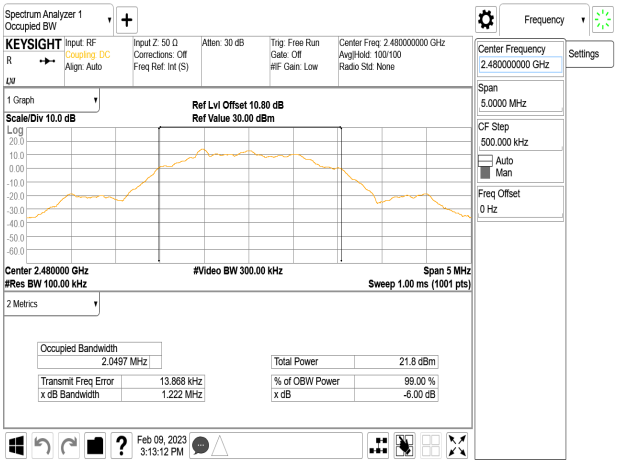

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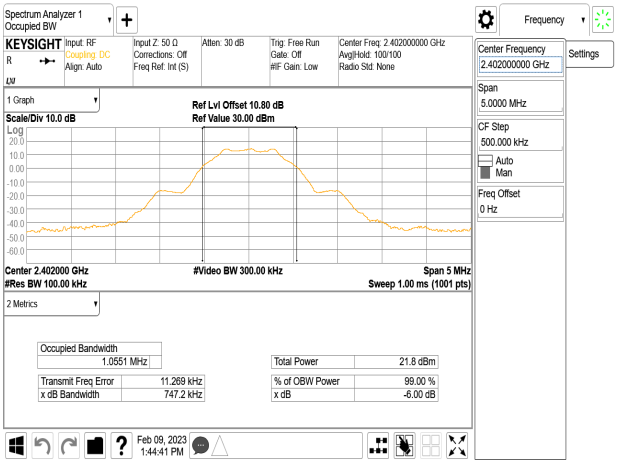
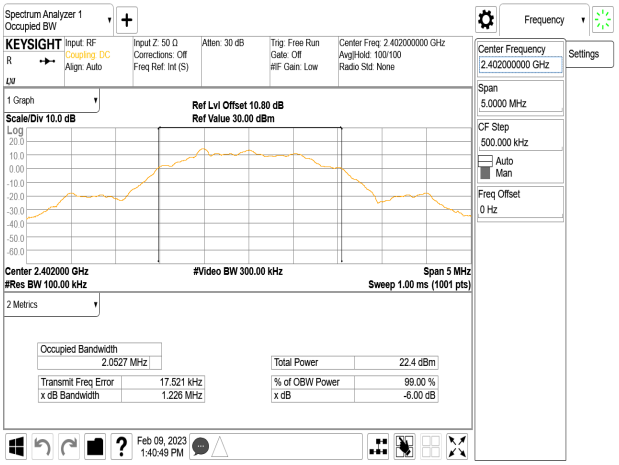
OBW_BLE 1M_LowCH00-2402MHz



OBW_BLE 2M_LowCH00-2402MHz



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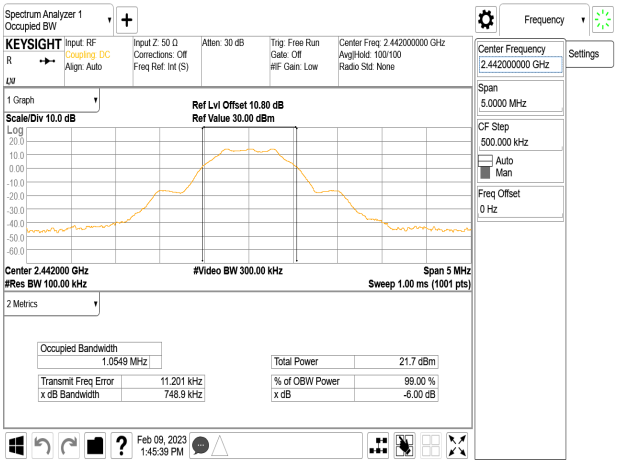
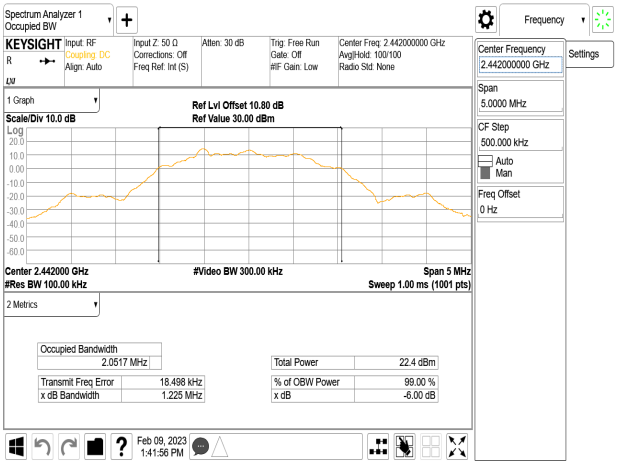
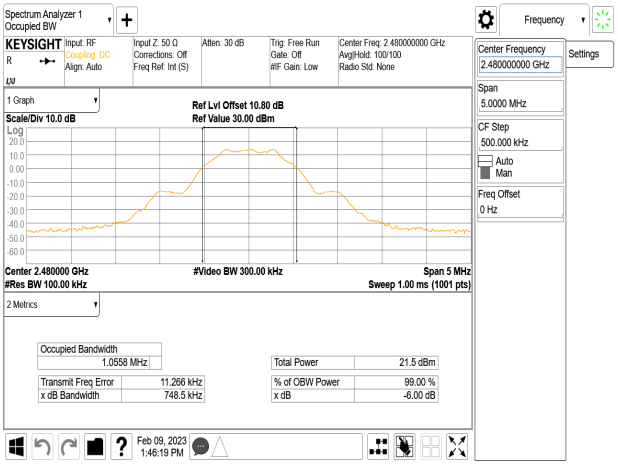


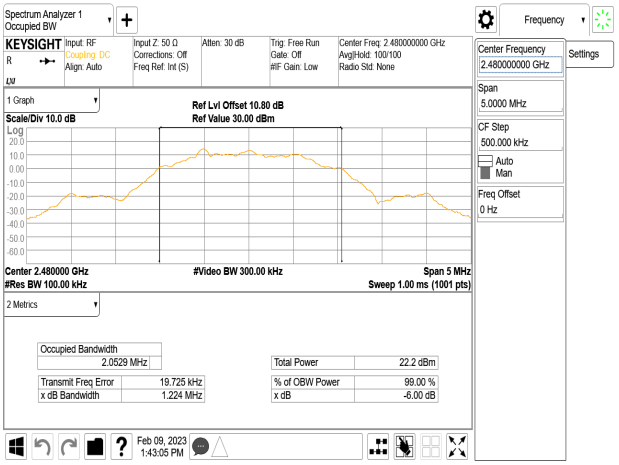
OBW_BLE 2M_MidCH20-2442MHz



OBW_BLE 1M_HighCH39-2480MHz



OBW_BLE 2M_HighCH39-2480MHz



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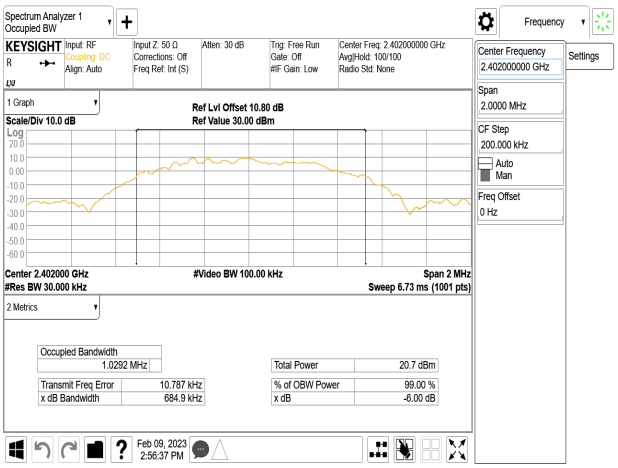
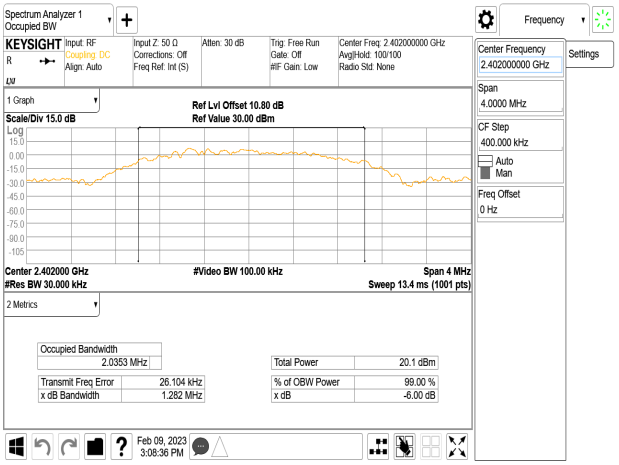
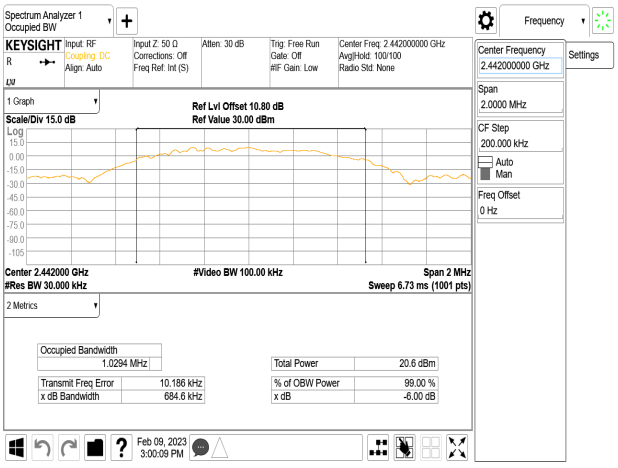
IC OBW_BLE 1M_LowCH00-2402MHz



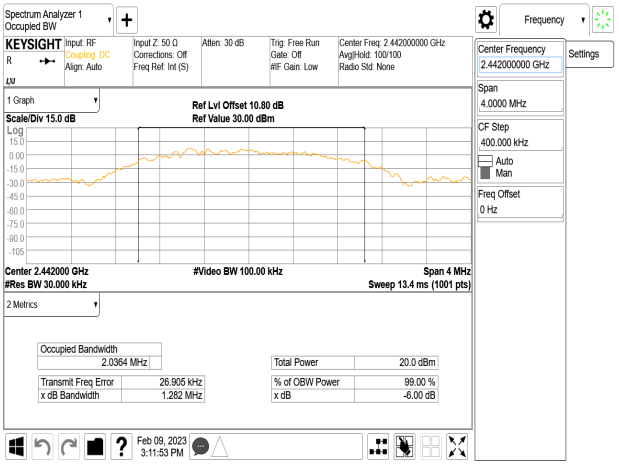
IC OBW_BLE 2M_LowCH00-2402MHz



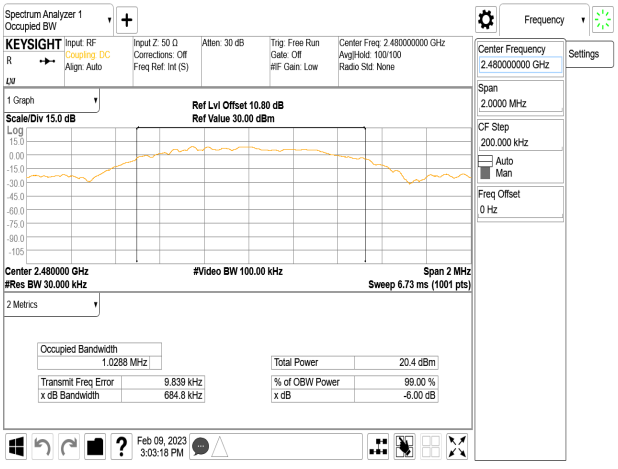
IC OBW_BLE 1M_MidCH20-2442MHz



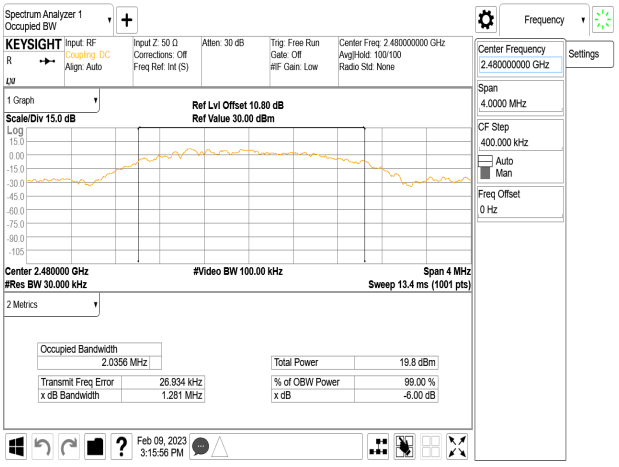
IC OBW_BLE 2M_MidCH20-2442MHz



IC OBW_BLE 1M_HighCH39-2480MHz

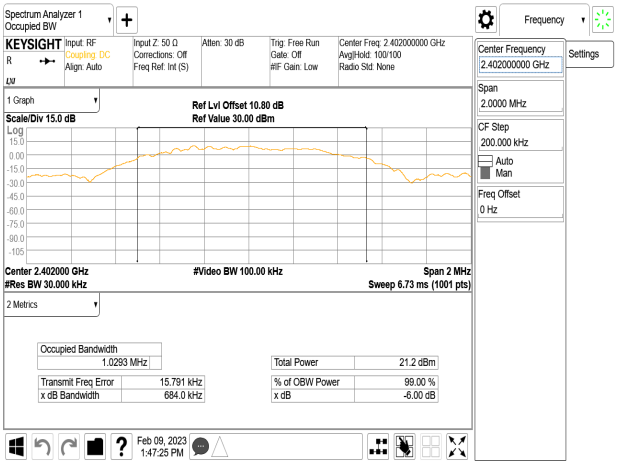


IC OBW_BLE 2M_HighCH39-2480MHz

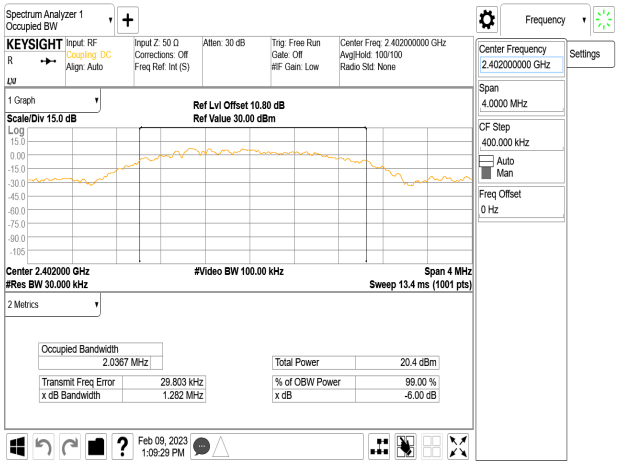


ANT1

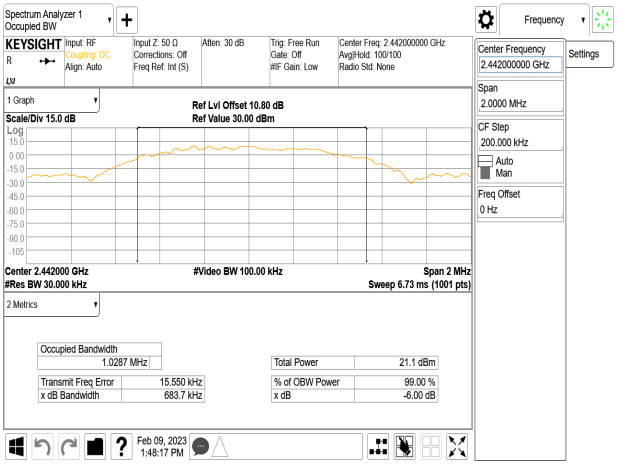
IC OBW_BLE 1M_LowCH00-2402MHz



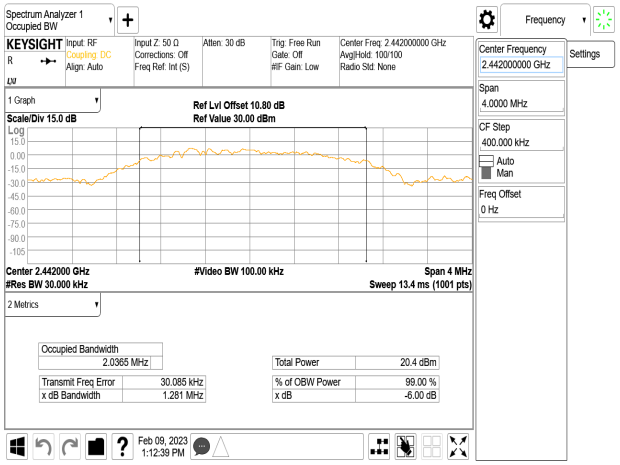
IC OBW_BLE 2M_LowCH00-2402MHz



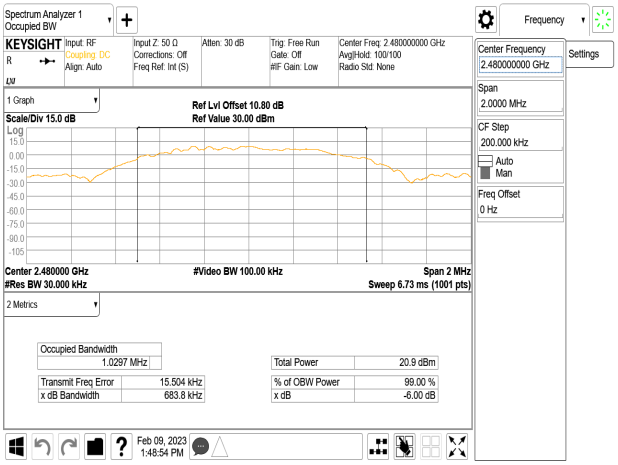
IC OBW_BLE 1M_MidCH20-2442MHz



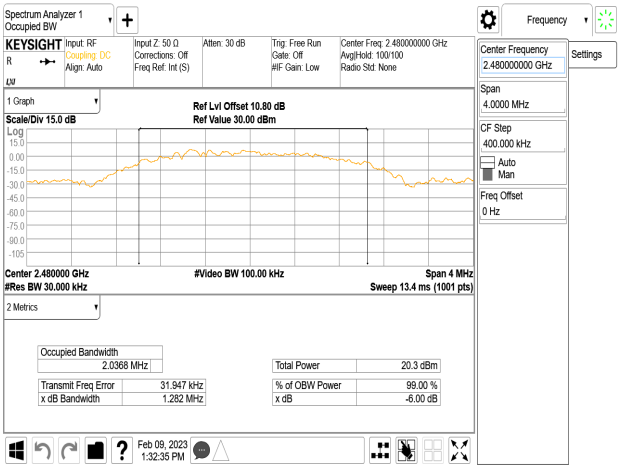
IC OBW_BLE 2M_MidCH20-2442MHz



IC OBW_BLE 1M_HighCH39-2480MHz



IC OBW_BLE 2M_HighCH39-2480MHz

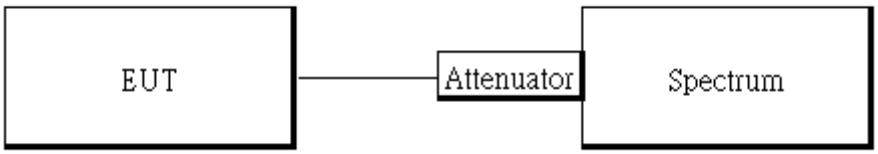


10 CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

10.1 Standard Applicable

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a) & RSS-Gen §8.10, must also comply with the radiated emission limits specified in §15.209(a) & RSS-Gen §8.9.

10.2 Test Setup



10.3 Measurement Procedure

10.3.1 Reference Level of Emission Limit:

1. Set analyzer center frequency to DTS channel center frequency.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
3. Set the span to 1.5 times the DTS channel bandwidth.
4. Set the RBW = 100kHz & VBW = 300 kHz.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level.

10.3.2 Conducted Band Edge:

1. To connect Antenna Port of EUT to Spectrum.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
4. Set start to edge frequency, and stop frequency of spectrum analyzer so as to encompass the spectrum to be examined.
5. Set the spectrum analyzer as RBW=100 kHz, VBW=300 kHz, Detector = Peak, Sweep = auto
6. Set DL as the limit = reading on marker of reference level measurement – 20dBm
7. Mark the highest readings of the emissions outside of 2400MHz~2483.5MHz.
8. Repeat above procedures until all default test channel (low and high) was complete.

10.3.3 Conducted Spurious Emission:

1. To connect Antenna Port of EUT to Spectrum.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
3. Set RBW = 100 kHz & VBW=300 kHz, Detector =Peak, Sweep = Auto
4. Allow trace to fully stabilize.
5. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.
6. Repeat above procedures until all default test channel measured were complete.

10.4 Measurement Result

ANT0

BLE 1M_Reference Level of Limit

Frequency (MHz)	RF Power Density (dBm)	Reference Level of Limit = PSD - 20dB (dBm)
2402	13.92	-6.08
2442	13.83	-6.17
2480	13.65	-6.35

NOTE: cable loss as 10.8dB that offsets in the spectrum

NOTE: Refer to next page for plots.

BLE 2M_Reference Level of Limit

Frequency (MHz)	RF Power Density (dBm)	Reference Level of Limit = PSD - 20dB (dBm)
2402	14.23	-5.77
2442	14.17	-5.83
2480	14.01	-5.99

NOTE: cable loss as 10.8dB that offsets in the spectrum

NOTE: Refer to next page for plots.

ANT1

BLE 1M_Reference Level of Limit

Frequency (MHz)	RF Power Density (dBm)	Reference Level of Limit = PSD - 20dB (dBm)
2402	14.34	-5.66
2442	14.23	-5.77
2480	14.04	-5.96

NOTE: cable loss as 10.8dB that offsets in the spectrum

NOTE: Refer to next page for plots.

BLE 2M_Reference Level of Limit

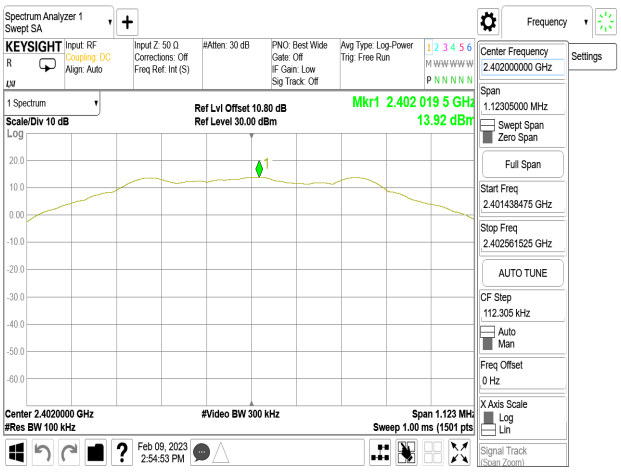
Frequency (MHz)	RF Power Density (dBm)	Reference Level of Limit = PSD - 20dB (dBm)
2402	14.59	-5.41
2442	14.45	-5.55
2480	14.43	-5.57

NOTE: cable loss as 10.8dB that offsets in the spectrum

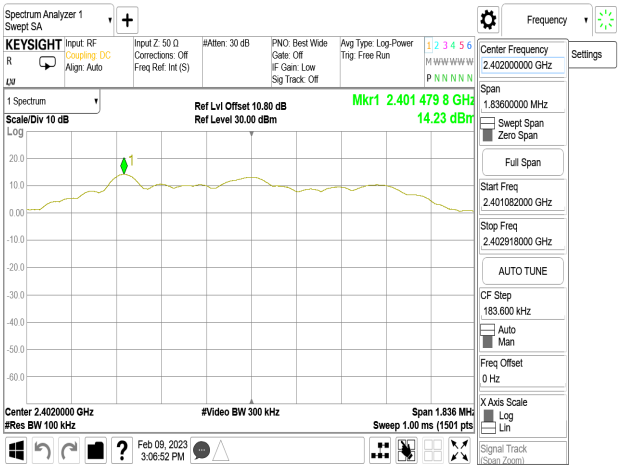
NOTE: Refer to next page for plots.

ANT0

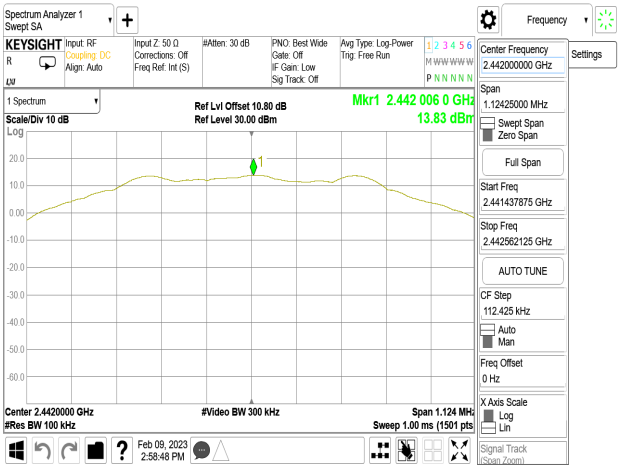
Reference Level_BLE 1M_LowCH00-2402MHz



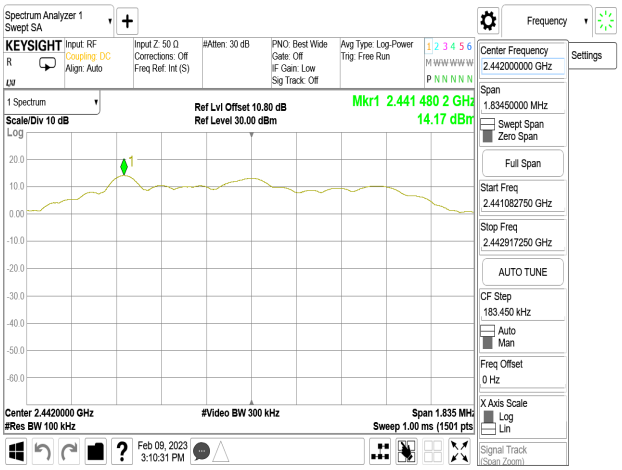
Reference Level_BLE 2M_LowCH00-2402MHz



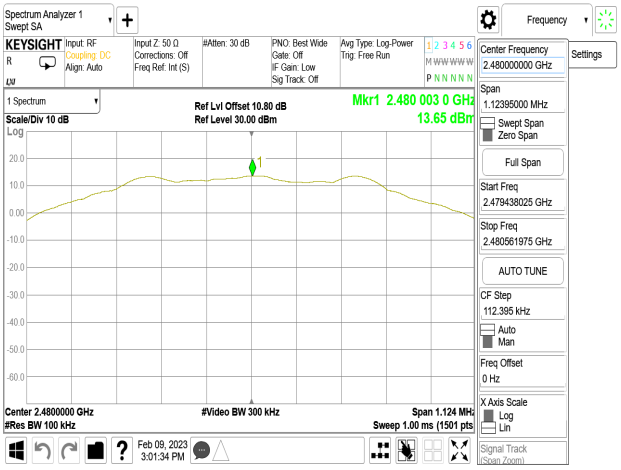
Reference Level_BLE 1M_MidCH20-2442MHz



Reference Level_BLE 2M_MidCH20-2442MHz



Reference Level_BLE 1M_HighCH39-2480MHz



Reference Level_BLE 2M_HighCH39-2480MHz